Lower and Middle Triassic Ammonites from Portuguese Timor (Palaeontological Study of Portuguese Timor, 4)

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Lower and Middle Triassic Ammonites from Portuguese Timor (Palaeontological Study of Portuguese Timor, 4)

By

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Abstract

Sixteen species of the Lower and Middle Triassic ammonites collected from Manatuto and Pualaca in the Portuguese east Timor Island are described. *Dieneroceras* fauna, *Leiophyllites* fauna and *Danubites* sp. in the west of Manatuto indicate the early Late Skythian (Owenitan), the Latest Skythian (Prohungaritan), and the Early Anisian age, respectively. *Leiophyllites*, *Tropigastrites* and *Procarnites* obtained from Pualaca are probably of the Earliest Anisian. These are the first occurrence of the Lower and Middle Triassic ammonites from the eastern part of the island with the exception of the occurrence of *Dinarites hirschii* described by WANNER from the ejecta of a mud volcano.

1. Introduction

In 1961 the senior author (K. N.) made a geologic excursion through the Portuguese Timor Island for about forty days with the assistance of two students of his university, Messrs. Hiroyuki SUZUKI and Toru TAKAHASHI. Because time was short, and members of the expedition were so few, only a little was done on the stratigraphy and geologic structure of the island, but a number of fossils were collected from various places, many of these being new localities. A part of the collection has already been described, namely, the Permian fusulinids by Y. NOGAMI (1963), the Triassic corals by N. YAMAGIWA (1963), and the Permain brachiopods by D. SHIMIZU (1966). The present paper treats with the Lower and Middle Triassic ammonites, all of which are new in the eastern part of the Timor Island. Associating conodonts as well as the Upper Triassic ones are described and discussed by Y. NOGAMI in the next article of the same memoirs.

The authors wish to express their cordial thanks to Messrs. H. SUZUKI and T. TAKAHASHI for the assistance in the field survey. Prof. H. YOSHIZAWA gave us a kind suggestion for metamorphic rocks. Dr. Y. NOGAMI and Mr. H. TERASHIMA

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helped us in preparation of figures. Acknowledgements are also due to these scholars.

2. Geologic Notes on the Fossil Localities

The Triassic cephalopod fossils have been obtained from three areas; west of Manatuto on the north coast, Pualaca district in the central part, and east of

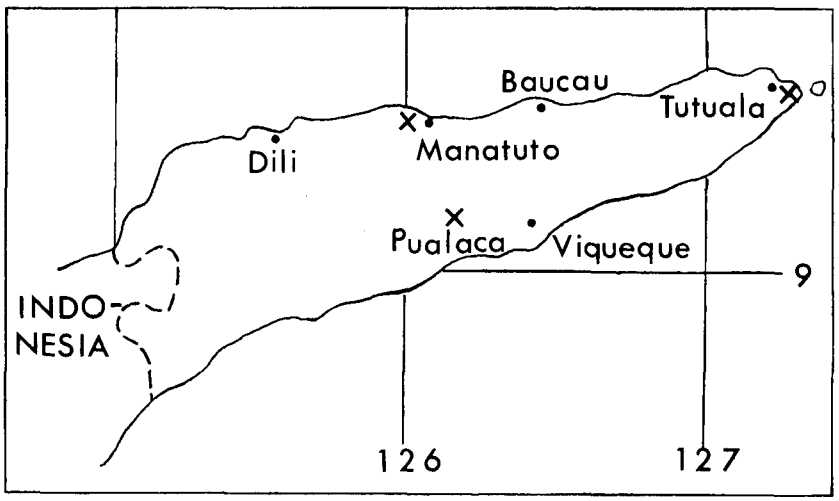

Fig. 1. Index map showing fossil localities (×).

Tutuala at the eastern end of the island (Text-fig. 1). Skythian and Anisian ammonites occurred in the former two areas, and Late Triassic ones in the last place.

(1) West area of Manatuto (Text-fig. 2)

The surveyed area covers the eastern end of the Hili Manu Range which runs along the north coast from Dili (capital of Portuguese Timor) to Vila de Manatuto of Manatuto Province. This area was explored by the Allied Mining Corporation (A.M.C.) for economic purposes. The west part is formed of amphibolites having more or less schistose texture. These rocks are considered to be part of the "North Coast Schist", which is widely distributed in the northern coastal range. The main part of the area consists of sedimentary rocks, such as "Fatu" limestones of the Permian? and Triassic ages, flysch-like alternations of sandstone and shale of the Mesozoic (Triassic?), and younger sediments of calcareous conglomerate. A serpentinite mass occupies a small area between amphibolites and the Mesozoic rocks. The relation of the three rock groups could not be observed.

The conglomerate bed is composed of pebbles and coarse sands mainly derived

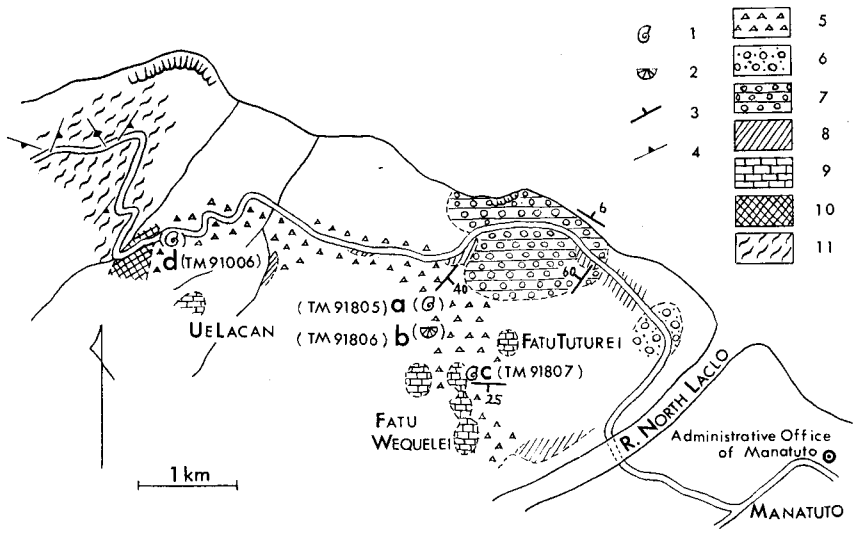

Fig. 2. Geologic sketch map of the west area of Manatuto
1. Fossil locality of ammonite, 2. Fossil locality of *Daonella*, 3. Bedding, 4. Foliation, 5. Rock debris, 6. Soft blocky deposit, 7. Pleistocene conglomerate, 8. Mesozoic alternation of shale and sandsonte, 9. Fatu limestone, 10. Serpentinite, 11. Amphibolite (Parentheses of 1 and 2 indicate a collection from a block.)

from the Hili Manu Range and contains abundant remains of coral and molluscs. A thin layer of coral reef is intercalated in it. The bed is cemented by calcareous matrices and comparatively hard, but is considered to be younger Pleistocene because some molluscs still preserve color-marking, although these are strongly bleached.

The underlying alternations of shale and sandstone or thinly stratified shales of purplish and greenish color make a low, gentle, hilly land. They are barren of fossils, but are referred to as the autochthonous Mesozoic complex by lithofacies.

Limestones are massive or poorly stratified, white or reddish in color, and build a "Fatu" topography, that is, rocky mounts steeply risen above the surrounding low land.

The surface of the low hilly land is covered by shattered rock debris of various sizes, composed mostly of limestone but with a little sandstone and shale. The contact relation between Fatu limestones and flysch-like alternations could not be observed, but a random distribution of the Fatu and the marked contrast of lithofacies of the two suggest the *Klippe* theory of the Fatu limestones thrust on the alternations as considered by many geologists (A. M. C., 1937; GRUNAU, 1953 and 1957; LEMOINE, 1959).

The Triassic fossils were found at four localities shown by **a-d** in Text-fig. 2,

all of which are contained in limestone slabs excepting locality **c**.

The limestone at loc. **a** (Coll. no. TM 91805) is reddish brown, compact, hard and poorly stratified. Many ammonites are embedded parallel to the stratification, and the interior of the shell is filled with white calcite. A few small bivalves, tentatively referred to as *Eumorphotis* (pl. 6, figs. 7, 8), are scattered in the same block. The following species are identified.

Ammonite

Dieneroceras dieneri (HYATT and SMITH) ..... abundant
Dieneroceras aff. *chaoi* KIPARISOVA ..... common
Anasibirites multiformis WELTER ..... common
Meekoceras nakazawai BANDO, n. sp. ..... very rare
Meekoceras sp. ..... very rare
Pseudosageceras cf. *multilobatum* NOETLING ..... rare
Hemiprionites sp. ..... very rare

Conodont

Diplododella triassica (MÜLLER), *Gondolella milleri* MÜLLER, *Hindeodella triassica* MÜLLER, *Lonchodina mülleri* TATGE, *Spathognathodus conservativa* (MÜLLER), *S. discreta* (MÜLLER), and others.

The conodonts agree quite well with those from the *Meekoceras* horizon of Nevada reported by MÜLLER (1956) and CLARK (1959). Ammonites also clearly indicate a lower horizon of the Upper Skythian, i.e., the Owenitan (to be discussed in the next section). Many Lower Triassic ammonites were reported from Indonesian Timor by WELTER (1922), but from Portuguese Timor *Dinarites hirschii* WANNER (1907) collected by HIRSCHI in 1904 is an only representative. The fossil was obtained from the ejecta of a mud volcano at Bibiluto southeast of Viqueque on the southern coast.

The limestone block collected at loc. **b** (Coll. no. TM 91806) is dark grey, finely crystallized, platy and crowded with shells of *Daonella indica* BITTNER, which indicate the Ladinian or early Karnian age. The provenance of this limestone is unknown. The associating conodonts are as follows:

Enantiognathus ziegleri (DIEBEL), *Gladigondolella abneptis* (HUCKRIEDE), *Gondolella navicula* HUCKRIEDE, *Hindeodella petraeviridis* HUCKRIEDE, *H. triassica* MÜLLER, *Lonchodina latidentata* (TATGE), *L. mülleri* TATGE, *Ozarkodina tortilis* TATGE, *Prioniodella ctenoides* TATGE, and others.

No cephalopods could be found in this limestone.

At the northeast foot of Fatu Wequelei (loc. **c**, Coll. no. TM 91807) a reddish brown, impure limestone stratified with dark purplish bands is exposed, running in an east-west direction with a dip of 20–30 degrees to the south. It contains abundant cephalopods, but the rock is too compact and hard to yield good speci-

mens. Only *Danubites* sp. could be identified, which suggests the Early Anisian age. Conodonts are not examined.

The limestone at loc. **d** (Coll. no. TM 91006) is grayish brown, massive, partly recrystallized and hard. The surface of ammonites is stained a brownish black color, and the interior is filled with white calcite. This limestone block is most probably derived from the Fatu limestones to the south of the fossil locality. The following species are recognized:

Ammonite

Leiophyllites timorensis BANDO, n. sp. ..... abundant
Leiophyllites sp. ..... rare
Procarnites aff. *kokeni* (ARTHABER) ..... very rare

Conodont

Diplododella triassica (MÜLLER), *Gladigondolella tethydis* (HUCKRIEDE), *Gondolella timorensis* NOGAMI, *Hindeodella multihamata* HUCKRIEDE, *H. petraeviridis* HUCKRIEDE, *H. triassica* MÜLLER, *Lonchodina latidentata* (TATGE), *L. mülleri* TATGE, *Ozarkodina saginata* HUCKRIEDE, *O. tortilis* TATGE, and others.

Judging from the ammonites, the age of the limestone refers to the Latest Skythian, rather than the Early Anisian.

Besides the above mentioned fossils an occurrence of slabs of the Permian crinoidal limestone was reported by A. M. C., and the senior author obtained a brachiopod of the Permian appearance from a massive, finely crystallized, reddish limestone at loc. **a**. Therefore, it is highly probable that the Fatu limestones in this area include various limestones ranging from the Permian up to the Ladinian or early Karnian.

(2) Pualaca district (Text-fig. 3)

Since HIRSCHI's exploration, Pualaca district has become famous for its abundant fossils and oil production, and was surveyed by A. M. C. in some detail. The senior author collected materials from five localities shown as **a-e** in Text-fig. 3.

Loc. **a** (Coll. no. TM 91206) is located at the northwest foot of Fatu Aubeon*, and roughly corresponds with WEBER's no. 38 (WANNER, 1956, Text-fig. 2). The Lower Permian fusulinids, such as *Codonofusiella weberi* (SCHUBERT), *Schwagerina nakazawae* NOGAMI, and *Parafusulina* sp. were described by NOGAMI (1963) from a limestone slab, which is considered to be originally contained in the basic tuffs as a lens.

At loc. **c** (Fatu Laculequi) a gray, massive limestone is exposed. Vinassa DE REGNY (1915) described many Late Triassic corals based on WEBER's collection from this place. YAMAGIWA (1963) reported the following corals collected by the

* In the previous paper, NOGAMI (1963) erroneously stated this site as the southeast foot of Fatu Auveon.

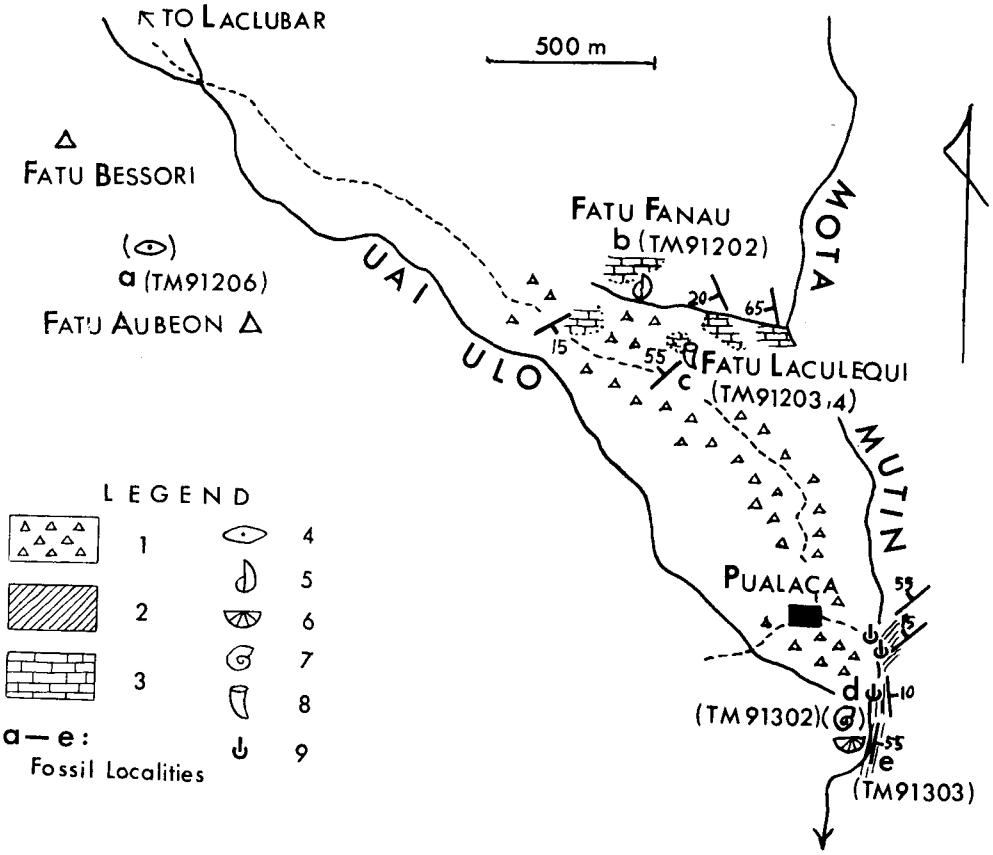

Fig. 3. Geologic route map around Pualaca
1. Rock debris, 2. Alternation of shale, marl, and marly limestone (Triassic), 3. Fatu limestone, 4. Fusulinid, 5. Brachiopod, 6. *Daonella*, 7. Ammonite, 8. Coral, 9. Oil seepage. (Parentheses indicate a collection from a block.)

senior author (Coll. no. TM 91203, 91204): *Thecosmilia* cf. *wanneri* DE REGNY, *Montlivaltia* sp., *Actinastrea*? sp., and *Thamnasteria* (*Astraemorpha*?) sp.

"**d**" is a locality of a cephalopod limestone boulder more than 1 meter in diameter at the junction of the Mota (river) Mutin and Uai Ulo River southeast of the native settlement of Pualaca. The limestone is pinkish white to reddish brown, hard and obscurely stratified, and very similar to the limestone at loc. **d** of Manatuto. It contains the following species of ammonite and conodont (Coll. no. TM 91302):

Ammonite

Leiophyllites aff. *pitamaha* DIENER ..... rare
Leiophyllites? sp. ..... very rare

Tropigastrites aff. *lahontanus* SMITH .....very rare
Ptychites? sp. .....very rare
Procarnites sp. .....very rare

Conodont

Gladigondolella tethydis (HUCKRIEDE), *Gondolella mombergensis* TATGE, *Neoprioniodus bicuspidata* MÜLLER, *N. bransoni* MÜLLER, *Spathognathodus conservativa* (MÜLLER), and others.

The horizon of this limestone is considered to be probably the Lowest Anisian. It is noticeable that *Daonella* sp. is found in the same block.

Along the river bank of the Mota Mutin near Pualaca thinly bedded alternations of variegated shale of chocolate brown or green color, pale greenish marly shale, and grayish limestone are well exposed. They are strongly controrted and considered to be autochthonous. Oil seepage at the river bed may come from these alternations. About 150 m from the junction of Uai Ulo downstream of the Mota Mutin (loc. **e**) abundant shells of *Daonella* were found congested in the alternations. These bivalves together with those from other localities will be described later.

(3) Tutuala district in Lautem Province (Text-fig. 4)

The Upper Triassic fossils were found around a settlement of Piti Leti at 0.9 km southeast-east from Tutuala* near the eastern end of the island. Fossiliferous

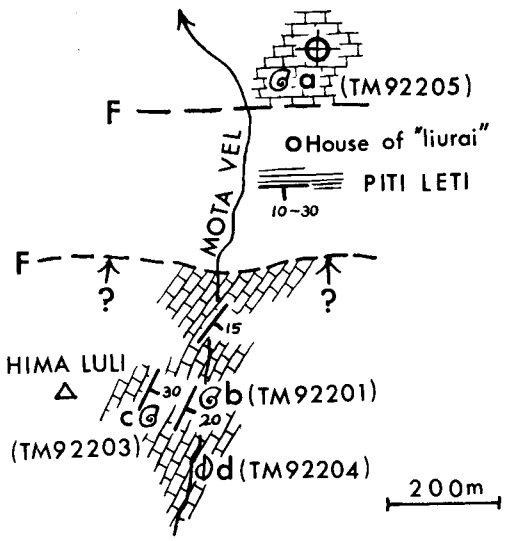

Fig. 4. Geologic sketch map around Piti Leti east of Tutuala. Legend is same as in Figure 3.

* Exact location of this place could be made by the information of Dr. M.G. AUDLEY-CHARLES of Imperial College in London, to whom the authors are much obliged.

limestones are distributed in two belts intercalating a narrow stripe of shale bed between them by inferred fault. The shale bed is composed of black, thinly laminated shale, locally purplish in color, and is considered to be a member of the autochthonous complex.

The limestone in the north belt is pale gray in color, compact, partly brecciated, obscurely bedded, and showing a nearly horizontal bedding plane. The flat surface of the limestone bed may indicate a raised, wave-cut terrace. Abundant, beautiful ammonites and some gastropods of the Late Triassic age were collected about 50 m north of the house of the *liurai* (local native chief). They will be described in the near future. The following conodonts are identified by NOGAMI (Coll. no. TM 92205):

Diplododella magnidentata (TATGE), *Enantiognathus ziegleri* (DIEBEL), *Gladigondolella abneptis* (HUCKRIEDE), *Gondolella navicula* HUCKRIEDE., *Hindeodella triassica* MÜLLER, *Lonchodina latidentata* (TATGE), *L. mülleri* TATGE, *L. spengleri* HUCKRIEDE, *Ozarkodina tortilis* TATGE, *Prioniodella ctenoides* TATGE, and others.

The limestone bed in the south belt makes a Fatu-like mountain. The bed is constituted of a dark gray, compact, hard limestone, which is irregularly bedded with a unit layer 20–30 cm in thickness and contains thin chert layers 3–7 cm in thickness. Ammonites are found sporadically, and are very difficult to dig out for examination. Although the lithic nature is somewhat different from that of the north limestone bed, the two beds are considered to be nearly contemporaneous with each other judging from the conodonts as enumerated below (Coll. no. TM 92203):

Gladigondolella abneptis (HUCKRIEDE), *Gondolella navicula* HUCKRIEDE, *Ozarkodina tortilis* TATGE, *Prioniodella ctenoides* TATGE, and others.

3. Faunal Consideration

Since the publication of the monograph by O. WELTER (1922) the beautiful Triassic ammonites in Timor have become famous. The Lower Triassic ammonites illustrated by previous authors (WELTER, 1922; SPATH, 1930, 1934; KUMMEL and STEELE, 1962) were all collected from the Indonesian part of Timor, except for *Dinarites hirschii* WANNER as mentioned already. They belong to the following genera:

Flemingites, Preflorianites, Anakashmirites, Owenites, Paraowenites, Pseudosageceras, Subvishnuites, Juvenites, Prionites, Kashmirites, Ussuria, Arctoceras, Meekoceras, "Tirolites", Hanielites, Pseudohedenstroemia, Pseudoflemingites, Subflemingites, Aspenites, Proptychites, Anasibirites, and *Hemiprionites.*

In his original paper WELTER (1922, p. 25) subdivided the Lower Triassic of

Timor into three beds with ammonites, namely the *Meekoceras* limestone, the *Owenites* limestone and the *Sibirites* limestone in ascending order. The majority of the above listed ammonites were obtained from the *Meekoceras* limestone and the *Owenites* limestone at Nifoekoko and Bihati.

The Triassic ammonites described here comprise the following species:

Dieneroceras dieneri (HYATT and SMITH)
Dieneroceras aff. *chaoi* KIPARISOVA
Anasibirites multiformis WELTER
Hemiprionites sp.
Meekoceras nakazawai BANDO, n. sp.
Meekoceras sp.
Pseudosageceras cf. *multilobatum* NOETLING
Procarnites aff. *kokeni* (ARTHABER)
Procarnites sp.
Leiophyllites timorensis BANDO, n. sp.
Leiophyllites aff. *pitamaha* DIENER
Leiophyllites sp.
Leiophyllites? sp.
Danubites sp.
Tropigastrites aff. *lahontanus* SMITH
Ptychites? sp.

Among these ammonites the ones belonging to the Lower Triassic consist of *Dieneroceras, Anasibirites, Hemiprionites, Meekoceras, Pseudosageceras, Leiophyllites*, and *Procarnites*. The first five genera predominate in the Upper Skythian and are especially characteristic of the fauna of the Owenitan ammonite stage (SPATH, 1930, 1934) or the fauna of the *Meekoceras gracilitatus* Zone (KUMMEL, 1957). Recently, KUMMEL and STEELE (1962, p. 647) reviewed the fauna of Timor and recognized them as representative of the Zone of *Meekoceras gracilitatus*. On the other hand, these are correlative with the fauna of the *Owenites* Zone of Olenekian age, or Upper Skythian in eastern Siberia. The genus *Leiophyllites* is known to range from the Uppermost Skythian to the Lower Anisian of the Middle Triassic, while *Procarnites* is confined to the Uppermost Skythian.

Among the described species in this paper, *Dieneroceras dieneri* (HYATT and SMITH) predominates in the Western United States and has been recorded from the Zone of *Meekoceras gracilitatus* of North America and the beds with *Meekoceras* of the Olenekian of the Upper Skythian stage in Eastern Siberia. The species of *Dieneroceras chaoi* KIPARISOVA was originally described from the Olenekian beds of Primorskii of Eastern Siberia and is one of the characteristic ammonites of the Owenitan. *Dieneroceras dieneri* and *D. chaoi* are clearly distinguishable from each

other by the whorl shape, but the species *D. chaoi* shows the closest similarity to *D. iwaiensis* from the upper Lower Triassic Iwai Formation of Japan in the general shell characters. The species *Anasibirites multiformis* and its varieties were first described by WELTER (1922, p. 138–145) from the "*Sibirites*" limestone of Timor. WELTER considered the *Anasibirites* beds to be the same horizon as the "*Sibirites*" bed of Kashmir, Himalaya, and the Upper Ceratite limestone of Salt Range. In the present collection from Portuguese Timor, *Anasibirites* is associated with *Dieneroceras, Hemiprionites, Meekoceras*, and *Pseudosagecras*, and accordingly, it is considered to be a representative form of the Owenitan. The limestone block at loc. **a** of Manatuto containing above mentioned species may safely be referred to as the lower Upper Skythian, that is, the Owenitan.

The species *Procarnites kokeni* is a characteristic ammonite of the Uppermost Skythian (KUMMEL, 1966). It is interesting that *P.* aff. *kokeni* is associated with many *Leiophyllites timorensis* n. sp. in the same block. The genus *Procarnites* is considered to be characteristic of the Uppermost Skythian, especially in the Zone of *Subcolumbites*, and associating *Leiophyllites timorensis* is rather primitive in the genus. Furthermore, the assemblage of *Leiophyllites* and *Procarnites* is reported from a block of black limestone in Kwangsi, south China, although not specifically identical with that of Timor. CHAO (1959) considered it to represent the highest horizon of the Lower Triassic, and KIPARISOVA and POPOW (1964) referred it to the Prohungaritan. Hence the limestone block at loc. **d** west of Manatuto is considered to be Uppermost Skythian rather than Lowest Anisian. On the other hand, another species of *Procarnites* is accompanied by *Tropigastrites* aff. *lahontanus, Leiophyllites* aff. *pitamaha, Leiophyllites*? sp., and *Pthychites*? sp. in the same limestone block at Pualaca. The former two species are limited to the Anisian. Consequently, it may be considered that the geologic horizon of the genus *Procarnites* ranges from the uppermost Skythian to the lower Anisian. The limestone boulder at Pualaca may be correlated to the Lowest Anisian judging from the coexistance of *Procarnites, Leiophyllites*, and *Tropigastrites*.

The limestone exposed at the northeast foot of Fatu Wequelei west of Manatuto (loc. **c**) is correlated to the Lower Anisian by the occurrence of *Danubites* sp., and probably a little younger in age than the just mentioned limestone at Pualaca.

In conclusion, the presence of the lower Upper Skythian (Owenitan), the Uppermost Skythian (Prohungaritan), the Lowest Anisian, and the Lower Anisian rocks is confirmed in the eastern Timor by ammonoid fossils. All of these are first in this part of the island with a single exception of the *Dinarites* bearing block from the mud volcano at Bibiluto. *Dieneroceras, Procarnites*, and *Tropigastrites* are new to the Timor Island including the western (Indonesian) part. GRUNAU's assumption (GRUNAU, 1957) that the original terrain of the *Decken* complex and a

part of the autochtonous cnmplex was uplifted over the sea in the eastern Timor during Early and Middle Triassic time should be re-examined by the fossil evidences stated above.

4. Systematic Description

by Y. BANDO

Family Dieneroceratidae KUMMEL, 1952

Genus *Dieneroceras* SPATH, 1934

Dieneroceras dieneri (HYATT and SMITH)

Pl. 4, Figs. 1–6; Text-fig. 5.

1905. *Ophiceras dieneri*, HYATT and SMITH. p. 118, pl. 8, figs. 16–29.
1932. *Ophiceras dieneri*, SMITH. p. 48, pl. 8, figs. 16–29.
1934. *Dieneroceras dieneri*, SPATH. p. 123, fig. 34.
1961. *Dieneroceras dieneri*, KIPARISOVA. p. 47, pl. 9, fig. 2.

Description: Form evolute, discoidal, laterally compressed, with wide umbilicus and narrowly rounded venter. Each whorls embracing the preceding one only slightly. The whorls show a roundly arched venter and rounded umbilical shoulders. The height of whorl is about 3/8 of the total diameter of shell. The umbilical width is almost equal to the height of the outer whorl. The width of the outer whorl is about 3/5 of the height. The inner whorls of the umbilical area show serpenticone coiling and are less compressed than the outer whorls. The flanks are convex and with the maximum width at half the height of the whorl. The

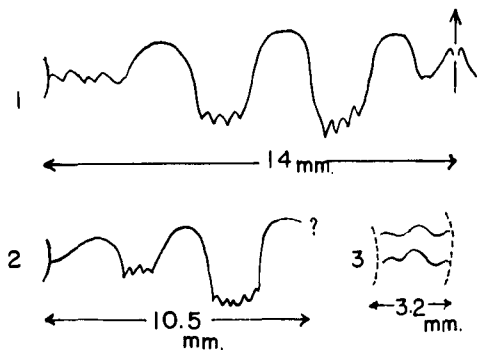

Fig. 5. Suture lines of *Dieneroceras dieneri* (HYATT and SMITH) 1 and 2. Adult form, 3. Immature form

venter is smooth, flat and rather narrowly arched. The surface is smooth and without ribs on the shell. Weak radial folds present on the inner whorls. The suture is visible and ceratitic. The external lobe is divided by a narrow siophonal saddle into two, small, slightly serrated lobes; the first lateral lobe considerably long and narrow, the second one short and small. Both lateral lobes denticulated with 3 or 4 points of corrugation. The lateral saddles are roundly arched, without serrations. The second lateral saddle is highest of all. The umbilical lobe faintly corrugated on the umbilical shoulder.

Measurements (in mm):

Reg. no.	D	H	W	U	H/D	W/H	U/D
TMM 20001	36	14.3	ca 9	12.5	0.40	0.63	0.35
TMM 20002	ca 41	ca 16	—	16	0.34	—	0.39
TMM 20003	45	15.5	9	19	0.34	0.58	0.42
TMM 20004	40	15	9	15	0.37	0.60	0.37
TMM 20007	37	13.5	7.5	14	0.37	0.55	0.38

Remarks: Six specimens were examined. Two of these specimens are complete and the others incomplete. *Ophiceras dieneri* was first described by HYATT and SMITH (1905) from the western United States, but subsequently, SPATH (1934) proposed the genus *Dieneroceras* as the genotype of "*Ophiceras*" *dieneri* HYATT and SMITH. Up to date, the species of *Dieneroceras* have been recorded from the *Meekoceras gracilitatus* Zone of North America (HYATT and SMITH, 1905; SMITH, 1932; KUMMEL, 1957; KUMMEL and STEELE, 1962), the Olenekian beds of Eastern Siberia (KIPARISOVA, 1961; POPOW, 1961, 62, 64), the Lower Triassic Iwai Formation of Japan (KUMMEL and SAKAGAMI, 1960), South China (CHAO, 1959), and from Albania (ARTHABER, 1908).

The present materials are almost identical with *Dieneroceras dieneri* from the Zone of *Meekoceras gracilitatus* of California and Idaho in North America. Especially, the whorl shape and sutures of the present specimens refer them to *D. dieneri*. Recently, KIPARISOVA (1961) described *D. dieneri* from the Olenekian beds of Russkii Island of eastern Russia, but compared with the Russian forms, the present materials show more compressed whorls. In the shape of cross section of the outer whorl the form illustrated by KUMMEL and SAKAGAMI (1960, pl. 3, figs. 1–4) is closest to the present materials.

Occurrence and geologic horizon: North of Fatu Wequelei, west of Manatuto (Coll. no. TM 91805). Upper Skythian (Owenitan).

Dieneroceras aff. *chaoi* KIPARISOVA

Pl. 4, Figs. 7, 8; Pl. 5, Fig. 1.

Compare:

1961. *Dieneroceras chaoi*, KIPARISOVA. p. 48, pl. 9, figs. 3–6.

Description: The shell very evolute, laterally compressed, conch discoidal with wide umbilicus and narrowly arched venter. The flanks are broadly arched and the umbilical shoulders broadly rounded. The umbilical whorls show serpenticone coiling of the conch and gradually becoming less compressed than the other whorls. The surface is smooth, without ribs and striations. The outer whorls slightly embrace the inner whorls. The width of umbilicus is about 1/2 of the total diameter of shell. The suture is ceratitic and consists of narrow ventral lobe, large first lateral lobe, narrow small second lateral lobe, and of roundly arched first and second lateral saddles. Ventral lobes divided into two narrow serrated lobes by small siphonal saddle, and the first lateral lobe denticulated into 3 points.

Measurements (in mm):

Reg. no.	D	H	W	U	H/D	W/H	U/D
TMM 20013	33	9.5	—	15.5	0.29	—	0.47
TMM 20014	47	13.5	8.5	23	0.28	0.63	0.49
TMM 20015	43	12.5	7.5	22.5	0.29	0.60	0.52
chaoi of ZAKHAROV	49.5	13.0	7.5	26	0.26	0.58	0.52

Remarks: Three specimens were examined. The materials most resemble *Dieneroceras chaoi* KIPARISOVA (1961) from the Primorskii and Ussuri Bay regions of Siberia in the whorl shape and umbilical form. However, the suture of the present material somewhat differs from the Siberian species in the ventral and lateral lobes. The general forms of the lateral saddles resemble those of *D. chaoi*. In the original description of *D. chaoi* KIPARISOVA (1961) did not show the ventral suture, but fortunately, the present author was able to study the same species which was kindly offered from Dr. Yu. ZAKHAROV of the Far East Geological Institute of Vladivostok in USSR. In the received specimen the ventral lobe of *D. chaoi* is smaller and shallower than that of *D. dieneri* and faintly serrated, but the lateral lobe are sometimes not denticulated. The umbilical whorls of *D. chaoi* resemble those of *D. iwaiense* (SAKAGAMI), but the first one is more compressed than that of the latter. These features are differences separating the present specimens from the other species of *Dieneroceras*, and also it is recognized that the character of the umbilical whorls shows a more compressed form and less embracing of the outer whorls.

Occurrence and geologic horizon: North of Fatu Wequelei, west of Manatuto. Upper Skythian (Owenitan).

Family Sibiritidae MOJSISOVICS, 1896

Genus *Anasibirites* MOJSISOVICS, 1896

Anasibirites multiformis WELTER, 1922

Pl. 5, Figs. 2–5.

1922. *Anasibirites multiformis*, WELTER. p. 138, pl. 169, figs. 9–27; pl. 170, figs. 1–3, 8–10.

1932. *Anasibirites multiformis*, SMITH. p. 73, pl. 79, fig. 18.

Description: The shell is discoidal, rather involute, laterally compressed with rounded venter and abruptly rounded umbilical shoulder. Umbilicus rather narrow. The surface is ornamented with faint striations and slightly progressive radial ribs. The costae cover the entire surface of flanks from the umbilical shoulder to the venter. The venter rather tabulated. Sutures fainltly observed in one specimen and consists of roundly arched, lateral lobes and not serrated lateral saddles on the flanks, but the ventral lobe is unknown because of poor preservation.

Measurements (in mm):

Reg. no.	D	H	W	U	H/D	W/H	U/D
TMM 20016	21	11	—	5	0.52	—	0.24
TMM 20017	30	17	—	6	0.57	—	0.20
TMM 20018	34	17	10	6	0.50	0.59	0.18
TMM 20019	23	11	7	4.2	0.48	0.64	0.17

Remarks: This species is exceedingly common in the *Anasibirites* beds of Timor as already mentioned by SMITH (1932, p. 73). The name *Anasibirites* was separated by MOJSISOVICS (1899) from the genus *Sibirites* MOJSISOVICS, 1886 (Genotype, *Sibirites pretiosus*) as a subgenus to include some species of *Sibirites* of WAAGEN (1895) from the Salt Range. The species of *Anasibirites* are variegated in the shell ornamentation, especially in the radial striations or ribbing character. The materials at hand show the characteristic surface ornamentation of *Anasibirites multiformis* WELTER and are thought to be almost identical with the named species in all points.

Occurrence and geologic horizon: North of Fatu Wequelei, west of Manatuto.

Upper Skythian (Owenitan).

Family Prionitidae HYATT, 1900

Genus *Hemiprionites* SPATH, 1929

Hemiprionites sp.

Pl. 5, Figs. 6a, b

Description: Shell involute, laterally compressed whorls, with tabulated venter and narrow umbilicus. Sides almost flattened, umbilical shoulders acute. The outer whorl embrace entirely the inner whorls. Septa faintly observed and consist of rounded saddles and serrated lobes, the ventral lobe unknown.

Measurements (in mm):

Reg. no.	D	H	W	U	H/D	W/H	U/D
TMM 20021	ca 35	13(17)	—	5.5	(ca.0.47)	—	0.16

Remarks: The general features of the whorls, venter and umbilicus most resemble those of *Hemiprionites* (SPATH, 1934), but precise identification for specific rank is impossible because of the poor preservation.

Occurrence and geologic horizon: North of Fatu Wequelei, west of Manatuto. Upper Skythian (Owenitan).

Family Meekoceratidae WAAGEN, 1895

Subfamily Meekoceratinae WAAGEN, 1895

Genus *Meekoceras* HYATT, 1879

Genotype: *Meekoceras gracilitatus* WHITE, 1879

The genus *Meekoceras* is one of the most common form in the ammonite fauna of the Lower Triassic and, up to date, the species of *Meekoceras* have been described from the western United States (HYATT, 1879; SMITH 1904; HYATT and SMITH, 1905; SMITH, 1914; MATHEWS, 1929; SMITH, 1932; SPATH, 1934; KUMMEL and STEELE, 1962), Arctic Canada (TOZER, 1961), Timor (WELTER, 1922), Japan (YEHARA, 1927; SHIMIZU and JIMBO, 1933; BANDO, 1964), China (TIEN, 1933; CHAO, 1959), Eastern Siberia (DIENER, 1895; KIPARISOVA, 1947, 1961; POPOW, 1964), India and

Pakistan (WAAGEN, 1895; DIENER, 1879, 1895; KRAFFT and DIENER, 1909), and from the Alps (ARTHABER, 1911; RENZ and RENZ, 1948). Among these world wide occurrences North America and Timor are the most typical localities of *Meekoceras*. The species of *Meekoceras* described here are all from a new locality of Timor, north of Fatu Wequelei, west of Manatuto, Port. Timor, and are found in association with *Anasibirites, Hemiprionites, Pseudosageceras,* and *Dieneroceras.*

Occurrence and geologic horizon: Western United States, Arctic Canada, Timor, Japan, China, Eastern Siberia, India, Pakistan, and the Alps. Upper Skythian (Owenitan).

Meekoceras nakazawai BANDO, new species

Pl. 5, Figs. 8a, b; Text-fig. 6.

Description: Conch evolute, discoidal, laterally compressed, with narrowly rounded venter and rather narrow umbilicus. The venter of the inner whorls narrowly tabulated, faintly biangular, as in the typical *Meekoceras*. Sides flattened, without folds or ribs, and gently convex from the abruptly rounded umbilical shoulders. The greatest thickness of the whorl lies at a point a little lower half the height, but in an inner whorl it lies at one-third height and the minimum thickness is at the ventral margin of the shell. The width of shell is about a half of the height and the diameter of the umbilicus is about one-fourth of the total diameter of the shell.

Septa ceratitic, consists of denticulated ventral and lateral lobes, and of rounded external and lateral saddles. The first lateral lobe is widest and denticulated into five points, but the second lateral lobe is narrow and denticulated into only one or two points. The ventral lobe is divided into two denticulated narrow lobes by birounded shallow siphonal saddle. The umbilical septa on the umbilical shoulder are denticulated into three or five points and they are clearly distinguishable from the lateral saddles.

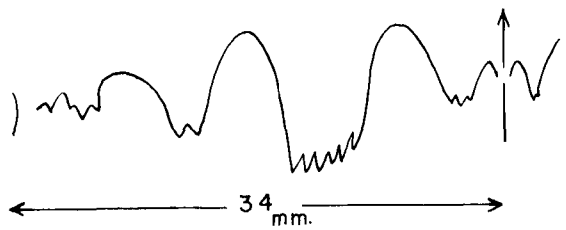

Fig. 6. Suture line of *Meekoceras nakazawai* BANDO, n. sp. (type specimen)

Measurements (in mm):

Reg. no.	D	H	W	U	H/D	W/H	U/D
TMM 20022 (Holotype)	59	30	16.6	9	0.51	0.55	0.15

Remarks: Judging from the whorl shape, umbilicus, ventral features, and septal characters, the present material belongs to the genus *Meekoceras*. The material is represented by only one specimen, however, the preservation is very good, especially in the septa. The general feature of the septa resembles those of *Meekoceras gracilitatus* WHITE from North America and the Arctic Region, but the distinct differences are observed between the present material and *M. gracilitatus* in the form of the umbilicus and ventral feature. The umbilicus of the present species is narrower than that of *M. gracilitatus* of North America. The species of *Meekoceras subcristatum* KIPARISOVA from Russia (KIPARISOVA, 1961) resembles the present form in septal features, but the Russian species shows more compressed whorl and has a wider umbilicus than that of the present material. No other similar species of *Meekoceras* could be found by the present author.

Occurrence and geologic horizon: North of Fatu Wequelei, west of Manatuto. Upper Skythian (Owenitan).

Meekoceras sp.

Pl. 5, Figs. 9a-c.

Description: Shell involute, laterally compressed, discoidal, with narrow umbilicus and rounded, arched venter. The outer whorl entirely embracing the inner whorls. The venter of the inner whorls tabulated. The surface of shell flattened, nearly smooth, slightly ornamented by faint, broad radial folds, and the umbilical shoulders abruptly rounded. The septa ceratitic, consisting of rounded saddles and denticulated lobes. The first lateral lobe widest and deeper than the others, and the lateral saddles considerably broad.

Measurements (in mm):

Reg. no.	D	H	W	U	H/D	W/D	U/D
TMM 20023	ca 53	ca 24	—	9	0.45	—	0.17
TMM 20024	59	28	ca 13	ca 9	0.47	0.46	0.15

Remarks: Two specimens were examined, and both lack their half part of

the outer whorls. But the general shape of whorls and sutures are well preserved. The sutures are those of *Meekoceras* and the cross section of the whorls has also a close resemblance to *Meekoceras*. This species is similar to the preceding one, but the suture line is somewhat different, especially in the denticulation of the first and umbilical lobes. Precise identification to specific rank is difficult.

Occurrence and geologic horizon: North of Fatu Wequelei, west of Manatuto. Upper Skythian (Owenitan).

Family Sageceratidae HYATT, 1900

Genus *Pseudosageceras* DIENER, 1895

Pseudosageceras cf. *multilobatum* NOETLING

Pl. 6, Figs. 1a, b, 2.

Compare:

1905. *Pseudosageceras multilobatum*, NOETLING. p. 181, pls. 19–27.
1905. *Pseudosageceras multilobatum*, HYATT and SMITH. p. 99, pl. 4, figs. 1–3; pl. 5, figs. 1–6; pl. 63, figs. 1–2.
1906. *Pseudosageceras multilobatum*, FRECH, in NOETLING. pl. 25, figs. 1a, b; pl. 26, figs. 3a, b.
1909. *Pseudosageceras multilobatum*, KRAFFT and DIENER. p. 145, pl. 21, fig. 5.
1911. *Pseudosageceras multilobatum*, WANNER. p. 181, pl. 7, fig. 4.
1922. *Pseudosageceras multilobatum*, WELTER. p. 94, fig. 3.
1929. *Pseudosageceras multilobatum*, MATHEWS. p. 3, pl. 1, figs. 18–22.
1932. *Pseudosageceras multilobatum*, SMITH. p. 87, pl. 4, figs. 1–3; pl. 5, figs. 1–6; pl. 25, figs. 7–16; pl. 60, fig. 32; pl. 63, figs. 1–6.
1932. *Pseudosageceras multilobatum*, KUTASSY. p. 630.
1934. *Pseudosageceras multilobatum*, SPATH. p. 54, fig. 63.
1934. *Pseudosageceras multilobatum*, COLLIGNON. p. 56–58, pl. 11, fig. 2.
1961. *Pseudosageceras multilobatum*, KIPARISOVA. p. 30, pl. 5, fig. 3.
1961. *Pseudosageceras multilobatum*, POPOW. p. 13, pl. 2, figs. 1–2.
1962. *Pseudosageceras multilobatum*, KUMMEL and STEELE. p. 701, pl. 102, figs. 1–2.

Description: Shell highly compressed, involute, discoidal, with closed umbilicus and flattened sides. The outer whorls completely embracing the inner whorls and the venter sharply acute. The shell surface smooth without ribs or striations. Septa consisting of numerous small lateral lobes, faintly denticulated into two or three points, and narrow lateral saddles, which are not serrated. The third lateral lobe is widest and more denticulated than those of any other lateral lobes. It is unfortunate that the ventral lobe can not be observed because the

ventral part of the shell is missing or poorly preserved.

Measurements (in mm):

Reg. no.	D	H	W	U	H/D	W/H	U/D
TMM 20025	47.0?	25.0	—	1?	0.53	—	0.02?

Remarks: Judging from the septa and whorl characters the present material clearly belongs to *Pseudosageceras*, and specifically it resembles *P. multilobatum* NOETLING. *P. multilobatum* is a very widespread ammonite and common species of the Lower Triassic. Originally, the suture of *P. multilobatum* is a characteristic of the lateral lobes and saddles, but precisely, faint differences are observed in the lateral lobes of each growth stage.

Occurrence and geologic horizon: North of Fatu Wequelei, west of Manatuto. Upper Skythian (Owenitan).

Family Proptychitidae WAAGEN, 1895

Subafmily Proptychitinae WAAGEN, 1895

Genus *Procarnites* ARTHABER, 1911

Procarnites aff. *kokeni* (ARTHABER)

Pl. 6, Figs. 3a, b.; Text-figs. 7, 8.

Compare:

1908. *Parapopanoceras kokeni*, ARTHABER. p. 259, pl. 11, figs. 1–2.
1911. *Procarnites kokeni*, ARTHABER. p. 215, pl. 17, figs. 16, 17; pl. 18, figs. 1–5.
1915. *Procarnites kokeni*, DIENER. p. 228.
1915. *Procarnites kokeni*, DIENER. p. 29.
1966. *Procarnites kokeni*, KUMMEL. p. 390, pl. 2, fi-s. 10–13.

Description: Shell laterally compressed, discoidal, with narrowly arched venter, small and deep umbilicus and flattened sides. Whorls widest at one-third height of flanks and almost equivalent to 1/3 of the total diameter of shell. The height of whorl is about a half of the total diameter of shell. Unfortunately, the sculpture or ornamentation of the surface is not preserved in the material at hand. Sutures are well preserved and consist of numerous small denticulated lateral saddles and lobes. The first lateral saddle is highest and wider than the other lateral saddles, and the ventral lobe narrow and divided into two small acute saddles by a narrow lobe.

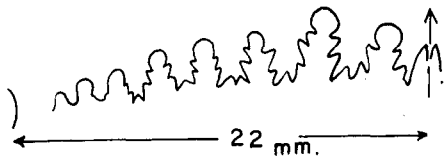

Fig. 7. Suture line of *Procarnites* aff. *kokeni* (ARTHABER)

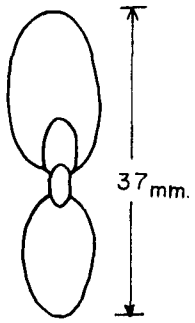

Fig. 8. Whorl section of *Procarnites* aff. *kokeni* (ARTHABER)

Measurements (in mm):

Reg. no.	D	H	W	U	H/D	W/H	U/D
TMM 20027	37.0	19.0	12.2	3.6	0.51	0.64	0.1

Remarks: A single specimen was studied, a half of the outer whorl being missing. Judging from the whorl shape, especially from the character of the umbilicus, cross section of conch and ventral shape, the material at hand closely resembles *Procarnites kokeni* (ARTHABER) of the *Subcolumbites* fauna of Kucira in Albania. The septa of *Procarnites* show a characteristic Ptychitid form and a highly advanced type in the Lower Triassic ammonites. Recently, an interesting new species of *Procarnites*, *P. modestus* was described by TOZER (1961, p. 38, pl. 1, figs. 1–6; text-fig. 12) from the Toad Formation of British Columbia as the latest Lower Triassic ammonite. On the other hand, the present material resembles the above Canadian species in the general form of conch and lateral septa, but clear differences are observed in the character of the ventral suture and moreover, our material shows more compressed whorls than the Canadian species. The other ammonite similar to *Procarnites kokeni* is "*Megaphyllites*" *immaturus* KIPARISOVA (1954, p. 22, pl. 12, fig. 4; 1961, p. 172, pl. 35, figs. 3–5; text-figs. 115–117) from the Olenekian beds of Primorye and the Russky Island. The septa of the present material closely resemble those of the above mentioned

Russian ammonite in the form of the ventral lobe, however, the width of the umbilicus and whorl section of present mateiral differs from the Russian species.

Occurrence and geologic horizon: About 7 km west of Manatuto. Uppermost Skythian (Prohungaritan).

Procarnites sp.

Pl. 6, Fig. 4; Text-figs. 9, 10.

Description: Whorls almost involute, discoidal, laterally compressed, with narrowly arched venter and narrow umbilicus. The umbilical shoulder is remarkable and its wall with steep angle showing funnel shape. Whorls very high, increasing rapidly, and the outer whorl almost embracing the inner whorls and deeply indented by the inner whorls. The width of the outer whorl is about 3/5 of the height, and diameter of umbilicus is about 1/3 height of the outer whorl. Surface smooth, with no ribs or striations. Sutures partly well preserved and consisting of numerous, small, submonophyllitic serrated saddles and subammonitic denticulated lobes, but the ventral sutures are not preserved.

Remarks: The Ptychitid ammonite of the present material unfortunately

Measurements (in mm):

Reg. no.	D	H	W	U	H/D	W/H	U/D
TMM 20028	—	25.8	14.4	7.5	—	0.56	—

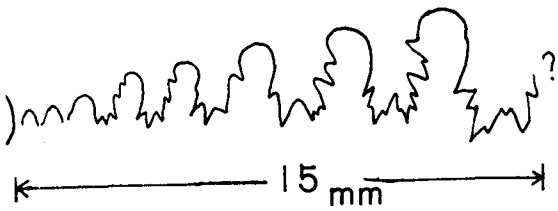

Fig. 9. Suture line of *Procarnites* sp.

Fig. 10. Whorl section of *Procarnites* sp. (Natural size)

lacks nearly a half part of the outer whorl, but the sutures, umbilicus and whorl section are well preserved for description. Judging from the shape of umbilicus, sutures, and whorl shape, the present material shows a close resemblance to *Procarnites kokeni* (ARTHABER) (ARTHABER, 1911, p. 215, pl. 17, figs. 16, 17; pl. 18, figs. 1–5) from Albania, but the Albanian species shows more compressed whorl in the adult form. The illustrated original species of ARTHABER seems to be variable in the shape of whorl section. Likewise, the specimens of *Procarnites skanderbegis* ARTHABER (ARTHABER, 1911, p. 216, pl. 18, figs. 6–7), which is another species similar to the present material in shell form and sutures, comprise many variable forms in the whorl section as illustrated by ARTHABER. Among the species of *Procarnites*, *Procarnites acutus* SPATH (SPATH, 1934, p. 183, pl. 5, fig. 4) from Albania and *P. oxynotus* CHAO (CHAO, 1959, p. 88, pl. 23, figs. 10–12) from south China have close resemblance in the shape of whorls and umbilicus. *P. oxynotus* CHAO is characteristic by considerably simple sutures on the umbilical sides compared with *P. kokeni* and *P. skanderbegis* from Albania. *Procarnites* have been mainly recorded from the Upper Skythian *Subcolumbites* horizon of Albania, Kwangsi, Greece, but the derscribed species is associated with *Leiophyllites*, *Tropigastrites* and *Ptychites*.

Occurrence and geologic horizon: From river gravel at Pualaca. Lowest? Anisian.

Family Ussuritidae HYATT, 1900

Genus *Leiophyllites* DIENER, 1915

Leiophyllites timorensis BANDO, new species

Pl. 7, Figs. 2–7; Text-fig. 11.

Description: Form evolute, discoidal, with serpenticone coiling, rounded venter and wide umbilicus. Whorl height increasing very slowly, outer whorl embracing slightly the inner whorls, and indentation of the inner whorls very shallow. The whorls rather laterally compressed. The shell surface smooth without any lateral ribs and constrictions in each whorls. The length of body chamber considerably long, about 2/3 volution of the outer whorl.

The suture lines consisting of denticulated lateral lobes, entire rounded lateral saddles and narrow ventral lobe. The ventral lobe is divided by small, narrow siphonal saddle and faintly denticulated at the marginal part of each side. The first lateral saddle and the second one show equal height and both narrowly arched at top; the lateral lobes denticulated into 3 points, and the umbilical lobe very short and not denticulated.

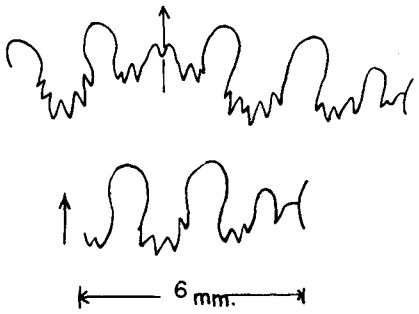

Fig. 11. Suture lines of *Leiophyllites timorensis* BANDO, n. sp.

Measurements (in mm):

Reg. no.	D	H	W	U	H/D	W/H	U/D
TMM 20029 (Holotype)	22.9	7.4	6.2	10.8	0.32	0.84	0.47
TMM 20030a	21.3	5.7	3.3	10.8	0.27	0.58	0.51
TMM 20030b	24.0	6.6	—	11.8	0.27	—	0.49
TMM 20031	18.4	4.0	4.9	10.2	0.21	1.23	0.55

Remarks: Five specimens were examined. The specimens at hand have close resemblance to *Leiophyllites suessi* (MOJSISOVICS) (MOJSISOVICS, 1882, p. 205, pl. 79, fig. 4, as *Monophyllites*; DIENER, 1915, p. 206; KRAUS, 1916, p. 289; KUTASSY, 1933, p. 595) in septa and whorl shape, but distinct differences are observed in the ventral lobe and cross section of the whorls from the above mentioned type-species of the genus. The other species from China, *Leiophyllites oxynotus* CHAO (CHAO, 1951, p. 150, pl. 42, figs. 11–12), resembles the present materials in the suture lines excepting the ventral lobe. Both *L. suessi* and *L. oxynotus* have close resemblance in every points. CHAO (1959) described some species of *Leiophyllites*, which includes *L.* aff. *pitamaha* (DIENER), *L. serpentinus* CHAO, *L. lolouensis* CHAO and *L. oxynotus*, from the "Columbitan" horizon of the limestone blocks in Lolou village, Linglo district of Kwangsi in China. The Siberian ammonite, *Leiophyllites praematurus* KIPARISOVA (KIPARISOVA, 1958, pl. 7, fig. 13; 1961, p. 134, pl. 28, figs. 5–6) resembles the present materials in the whorl shape and sutures (p. 135, fig. 101, b) excepting the umbilical series. Considering the general characters of the material the present author believes that the described species shows closest resemblance to *L. suessi* (MOJSISOVICS) which was recorded from the Alps, Bosnia, Albania, Greece, Roumania, Anatolia and Tonkin.

Occurrence and geologic horizon: About 7 km west of Manatuto. Uppermost Skythian (Prohungaritan).

Leiophyllites sp.

Pl. 4, Fig. 8.

Description: Conch evolute, rather laterally compressed, serpent-shaped coiling, with wide umbilicus and rounded ventral shoulders. The umbilical shoulders rounded, but indistinct. Surface smooth, no ribs or striations. Sutures ceratitic, but simple, with rounded saddles and faintly denticulated lateral lobes.

Measurements (in mm):

Reg. no.	D	H	W	U	H/D	W/H	U/D
TMM 20033	23.8	6.2	6.0	10.3	0.27	0.97	0.43

Remarks: The present specimen from Manatuto unfortunately lacks less than a half part of the outer whorl and is slightly deformed. The general features of the shell and umbilicus have a resemblance to *Leiophyllites*, but the specific identification is impossible because of poor preservation of the septa and the outer whorl.

Occurrence and geologic horizon: About 7 km west of Manatuto. Uppermost Skythian (Prohungaritan).

Leiophyllites aff. *pitamaha* DIENER

Pl. 7, Figs. 1a, b; Text-fig. 12.

Compare:

1895. *Monophyllites pitamaha*, DIENER. p. 107, pl. 31, figs. 7a-c, 5? and 8?.

1915. *Leiophyllites pitamaha*, DIENER. p. 205.

Description: Shell evolute, laterally compressed, with acute, narrow venter and wide umbilicus. Whorl section compressed elliptical, the umbilical shoulders sloping gently, the ventral shoulders indistinct. The height of whorl is about 1/3 diameter of shell, the umbilical width is a little larger than 1/3 total diameter of shell, the width of shell is about a half of the umbilical diameter and about 5/8 height of the last whorl. The shell surface is ornamented with blunt, radial, irregular ribs, which are most prominent on the umbilical margin and gradually become indistinct at the half height of the shell, the surface of the ventral side is almost flattened as in *Gymnites*. Septa ceratitic, consisting of rounded, entire high saddles, denticulated lateral lobes, and slightly denticulated ventral lobe. The first lateral lobe deepest and wider than the other lobes. The ventral lobe divided

into shallow lobes by triangular, narrow siphonal saddle.

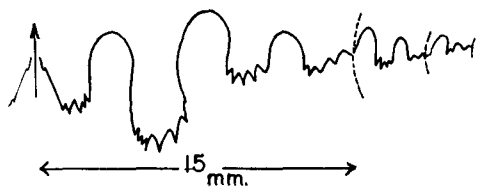

Fig. 12. Suture line of *Leiophyllites* aff. *pitamaha* DIENER

Measurements (in mm):

Reg. no.	D	H	W	U	H/D	W/H	U/D
TMM 20035	62.6?(48.8)	21.8(16.5)	10.9	26.6(20.0)	0.35	0.5	0.43

Remarks: Only a single specimen was examined. The sutures of the present material show characteristic features of the genus *Leiophyllites*, but the general character seemingly retains those of the young *Gymnites*. Among the species of *Leiophyllites* the material at hand closely resemble *L. pitamaha* DIENER from the Himalayan Muschelkalk in the whorl shape and sutures, but the lateral lobes are more denticulated than those of the Hiamalayan species. The another Himalayan species, *Leiophyllites? middlemissi* (DIENER) (DIENER, 1895, p. 11;, pl. 30, fig. 6; SPATH, 1934, p. 308) is also alike the present material in the sutures, but the Himalayan form is more compressed than the Timor material in whorl section. SPATH(1934, p. 309) says that *Leiophyllites? middlemissi* (DIENER) possibly belongs to a young *Gymnites* and *Leiophyllites indo-australicus* (WELTER) (WELTER, 1915, p. 129, pl. 93, figs. 4–5) from the Anisian limestone with *Sturia mongolica* of Timor may be intermediate forms between *L.* (?) *middlemissi* and *L. pitamaha*. The present author also thinks that both *L. pitamaha* and *L.? middlemissi* have a close relation with *Gymnites*.

Occurrence and geologic horizon: From river gravel at Pualaca. Lowest? Anisian.

Leiophyllites ? sp.

Pl. 7, Fig. 9.

Description: Evolute, slightly depressed whorls, with slowly increasing volutions and wide umbilicus. Shell surface smooth, and the umbilical shoulders indistinct. Suture line not preserved.

Measurements (in mm):

Reg. no.	D	H	W	U	H/D	W/H	U,D
TMM 20036	37.0	10.5	—	22.4	0.28	—	0.6

Remarks: The present specimen resembles *Leiophyllites confucii* (DIENER) (DIENER, 1895, p. 107, pl. 30, fig. 7) in general form of the whorl, but the Himalayan species mentioned above has a more loosely coiled shell than this specimen. *Leiophyllites taramelli* (MARTELLI) (1906, p. 135, pl. 6, figs. 3–4) from Bosnia and Albania, also resembles the present material, but precise identification is impossible because of the poor preservation of the material at hand. Essentially, loosely coiled *Leiophyllites confucii* and *L. taramelli* are both difficult to distinguish from each other by the shell features.

Occurrence and geologic horizon: From river gravel at Pualaca. Lowest? Anisian.

Family Danubitidae SPATH, 1951

Genus *Danubites* MOJSISOVICS, 1893

Danubites sp.

Pl. 6, Figs. 9a, b; Text-fig. 13.

Description: Form evolute, slightly compressed laterally, with smoothly rounded venter and rounded umbilical shoulders. Whorl sides flattened and ornamented with prominent radial ribs. Septa ceratitic, consisting of highly rounded saddles and denticulated lateral lobes. The umbilical lobe is narrow and separated by narrow, acute siphonal saddle and the first lateral lobe is deepest and wider than the others. The external saddle is situated on the ventral shoulder and is broader than the other saddles. The umbilical series is considerably short and situated on the umbilical wall.

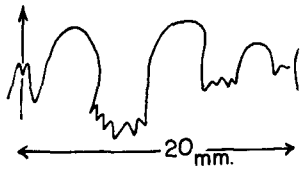

Fig. 13. Suture line of *Danubites* sp.

Measurements (in mm):

Reg. no.	D	H	W	U	H/D	W/H	U/D
TMM 20037	66.2	20.2	—	30.8	0.31	—	0.46

Remarks: A half volution of the outer whorl and the inner volutions of the umbilicus are unfortunately missing in the present material. Nevertheless, the preservation of the shell and sutures is rather good. Judging from the whorl section, sutures and shell ornamentation the material belongs to *Danubites*, but its determination to specific rank is impossible because the umbilical whorls are lacking.

Occurrence and geologic horizon: Northeast foot of Fatu Wequelei, west of Manatuto. Lower Anisian.

Family Celtitidae Mojsisovics, 1893

Genus *Tropigastrites* Smith, 1914

Tropigastrites aff. *lahontanus* Smith

Pl. 5, Fig. 7; Text-figs. 14, 15.

Compare:

1934. *Tropigastrites lahontanus*, Smith. p. 28, pl. 19, figs. 14, 15, 16?. 17, 18, 19, 22 and 23(*non* figs. 15, 20, 21, 24, 25 and 26).

Description: Form evolute, laterally compressed, widely umbilicated, with narrowly arched venter. The sides gently convex from the umbilical shoulder to the ventral side. Umbilical shoulder rounded. Surface ornamented with weak radial folds on the flanks of the outer whorl, and the surface on the umbilical whorls has more distinct radial ribs. Septa are ceratitic, but only partly preserved on the flanks.

Measurements (in mm):

Reg. no.	D	H	W	U	H/W	W/H	U/D
TMM 20038	—	19.9	15.5?	26.6	—	0.78	—

Remarks: The outer whorl is partly missing, but the shell shape, umbilicus and ornamentation are well preserved. Concerning the ornamentation of shell

Fig. 14. Suture line of *Tropigastrites* aff. *lahontanus* SMITH

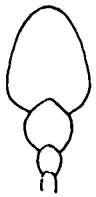

Fig. 15. Whorl section of *Tropigastrites* aff. *lahontanus* SMITH (natural size)

and whorl section of the outer whorl the present material has a close resemblance to *Tropigastrites lahontanus* SMITH (SMITH, 1934, p. 28, pl. 19, figs. 14–15, type specimen) from the Beds of the *Daonella dubia* Zone, *Paraceratites trinodosus* subzone, of the West Humboldt Range of Nevada, but from the latter it slightly differs in the feature of the septa. According to the recent paper of SILBERLING (1962, p. 153–160) the stratigraphical horizon of *T. lahontanus* is the *Gymnotoceras blakei* beds of the *Gymnotoceras* Zone at Fossil Hill, Humboldt Range of Nevada. The genus *Tropigastrites* resembles the Lower Triassic *Preflorianites* in the ornamentation, but the genus *Tropigastrites* shows a more varied shell ornamentation. Concerning this fact, SPATH(1951, p. 100) also stated that the Californian species of *Tropigastrites*, described by SMITH, comprises varieties of strongly or feebly ribbed species, and from the depressed type to the compressed type within a single species.

Occurrence and geologic horizon: From river gravel at Pualaca. Lowest? Anisian.

Family Ptychitidae MOJSISOVICS, 1882

Genus *Ptychites* MOJSISOVICS, 1875

Ptychites? sp.

Pl. 6, Figs. 5, 6.

Description: Shell involute, discoidal, with flattened sides and narrow, highly rounded venter. The umbilicus shows a funnel shape, surrounded by steeply inclined inner wall. The umbilical width rather narrow and the inner volution slightly exposed inside the umbilicus. The sides flattened and ornamented with radial ribs which run from the umbilical shoulders to the portion of half height of whorl, but the ventral sides almost flattened and smooth without any ribs. The greatest thickness of the outer whorl is at the umbilical margin. Suture unknown.

Measurements (in mm):

Reg. no.	D	H	W	U	H/D	W/H	U/D
TMM 20039	—	31.6	14.0	17.7?	—	0.44	—

Remarks: The material at hand lacks about 2/3 portion of the outer whorl, but the umbilicus, ornamentation of shell and the whorl section are well observable. The general form of the shell resembles *Ptychites mahendra* DIENER (1895, p. 80, pl. 16, figs. 1–2) from Spiti, but specific identification of our material is impossible because of the poor preservation.

Occurrence and geological horizon: From river gravel at Pualaca. Lowest? Anisian.

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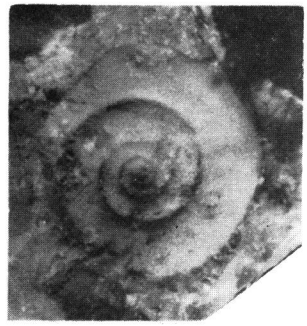
Explanation of Plate 4

Figs. 1–6. *Dieneroceras dieneri* (HYATT and SMITH) ..... p. 93
1. Reg. no. TMM 20006, ×1.4; 2. Reg. no. TMM 20005, 2a×1, 2b×2; 3. Reg. no. TMM 20007, ×1; 4. Reg. no. TMM 20002, ×1; 5. Reg. no. TMM 20004, ×1.7; 6. Reg. no. TMM 20001, ×1.4.

Figs. 7, 8. *Dieneroceras* aff. *chaoi* KIPARISOVA ..... p. 95
7. Reg. no. TMM 20014, ×1.3; 8. Reg. no. TMM 20015, ×1.2.

All illustrated specimens were collected from loc. **a**, west of Manatuto (Coll. no. TM 91805), Upper Skythian (Owenitan).



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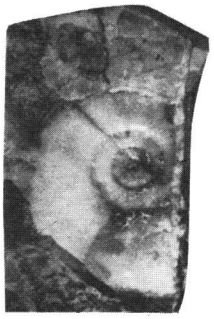

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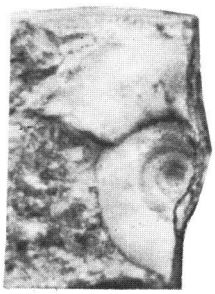

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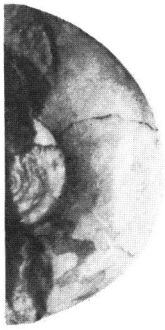

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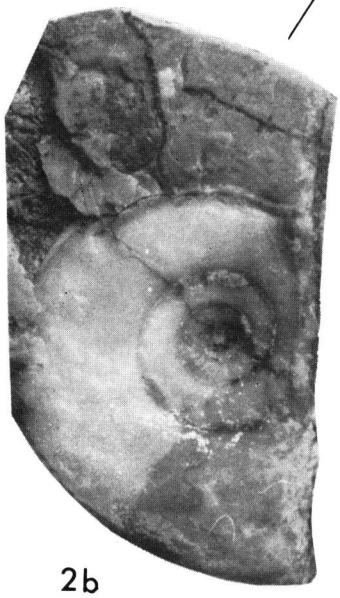

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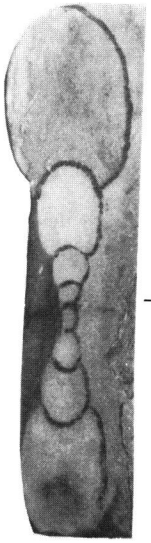

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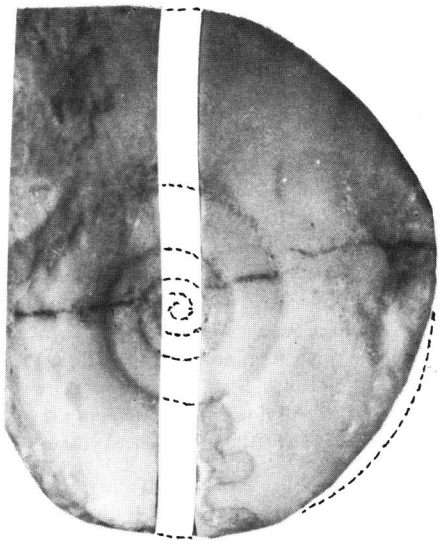

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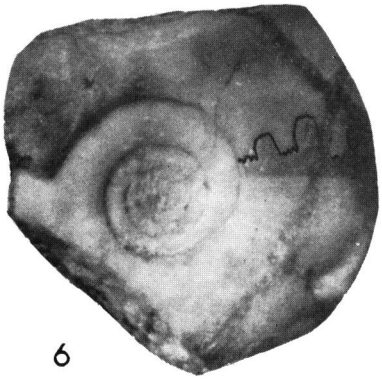

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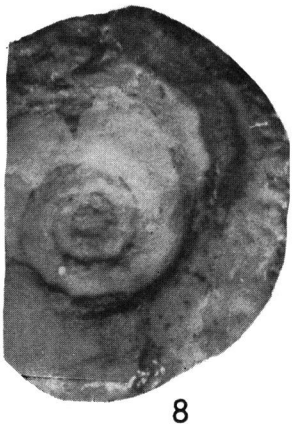

8

NAKAZAWA and BANDO, Triassic Ammonites from Timor

Explanation of Plate 5

Fig. 1. *Dieneroceras* aff. *chaoi* KIPARISOVA.....p. 95
Reg. no. TMM 20013, ×1.3.

Figs. 2–5. *Anasibirites multiformis* WELTER .....p. 96
2. Latex cast, Reg. no. TMM 20017, ×1.5; 3. Gypsum cast, Reg. no. TMM 20016, ×1.5; 4. External mould, TMM 20019, ×2; 5. Latex cast, Reg. no. TMM 20044, ×1.5.

Figs. 6a, b. *Hemiprionites* sp.....p. 97
Reg. no. TMM 20021, ×0.8.

Fig. 7. *Tropigastrites* aff. *lahontanus* SMITH.....p. 109
Reg. no. TMM 20038, ×1.2, collected from the limestone boulder of the Mota Mutin, Pualaca (Coll. no TM 91302), lowest? Anisian.

Figs. 8a, b. *Meekoceras nakazawai* BANDO, n. sp.....p. 98
Reg. no. TMM 20022, natural size, holotype.

Figs. 9a-c. *Meekoceras* sp.....p. 99
Reg. no. TMM 20023, (a) gypsum cast, natural size; (b) and (c) ×1.2.

All illustrated specimens excepting Fig. 8 were collected from loc. **a** west of Manatuto (Coll. no. TM 91805), Upper Skythian (Owenitan).


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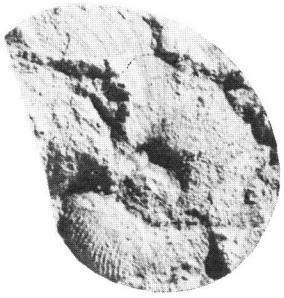
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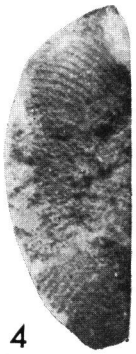
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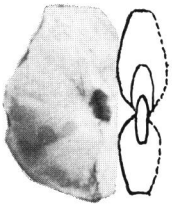
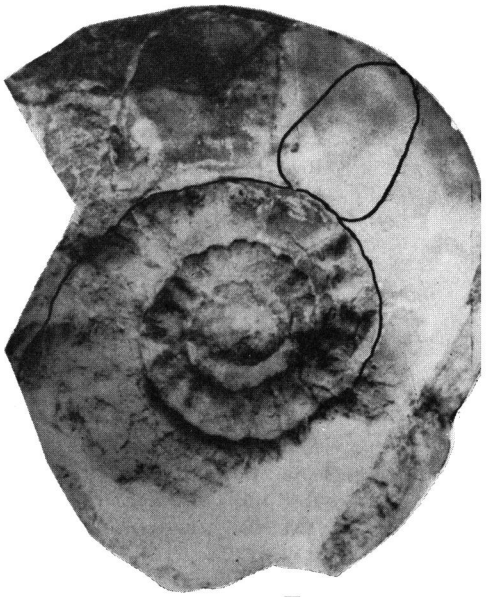

6a 6b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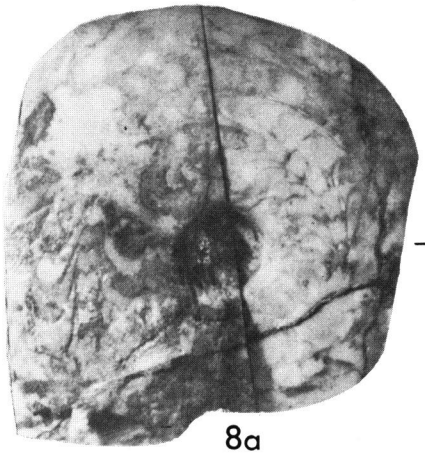
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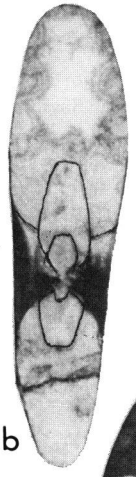
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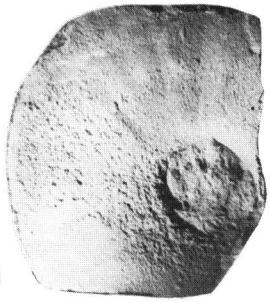
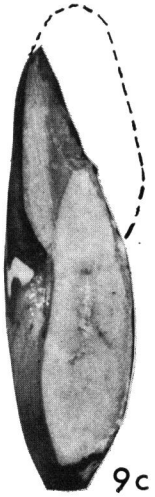

9a


9b


9c

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Explanation of Plate 6

Figs. 1, 2. *Pseudosageceras* cf. *multilobatum* NOETLING .....p. 100
1. Reg. no. TMM 20026, ×2; 2. Reg. no. TMM 20025, natural size, collected from loc. **a**, west of Manatuto (Coll. no. TM 91805), Upper Skythian (Owenitan).

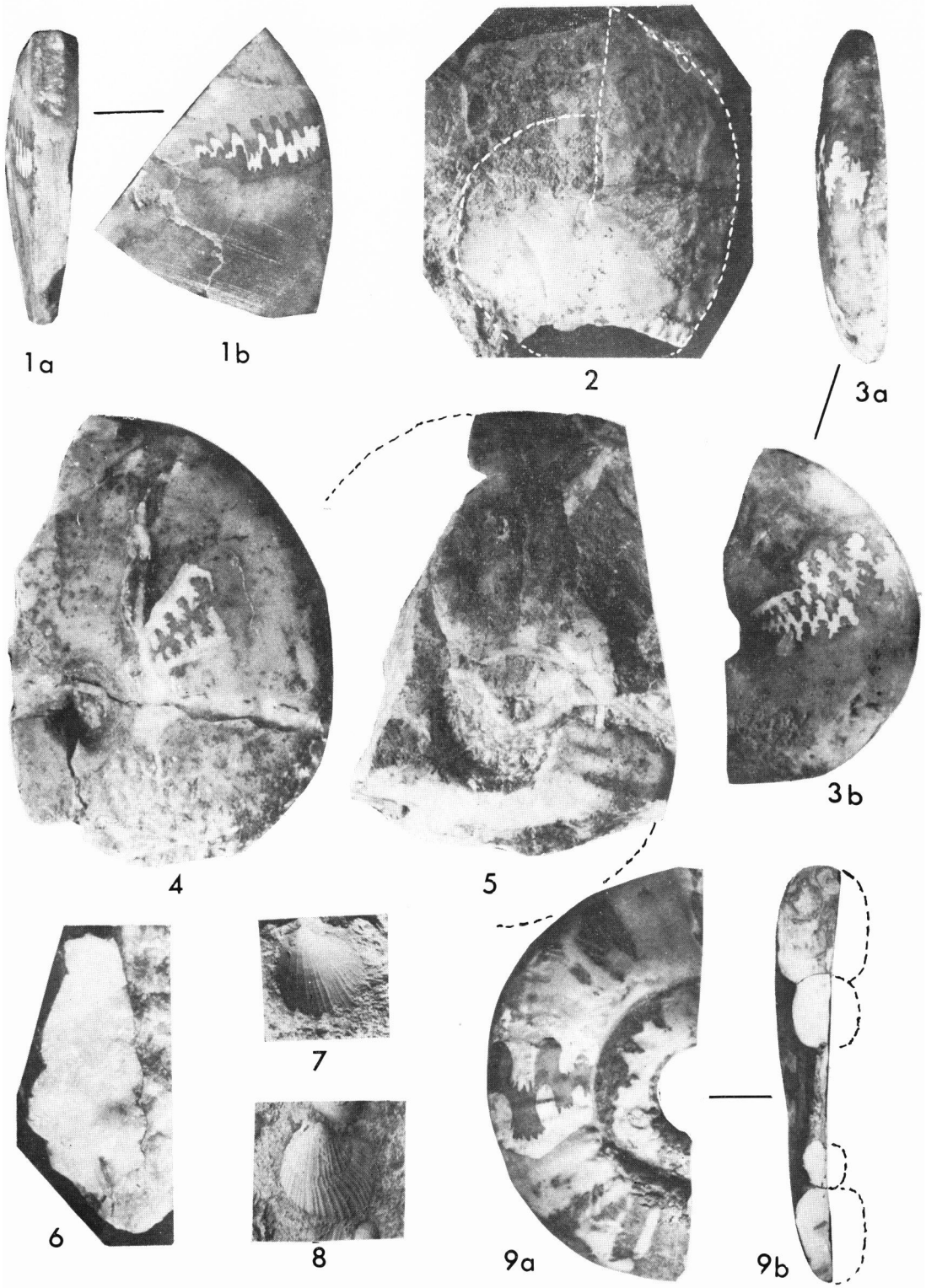
Figs. 3a, b. *Procarnites* aff. *kokeni* (ARTHABER) .....p. 101
Reg. no. TMM 20027, ×1.5, collected from loc. **d**, west of Manatuto (Coll. no. TM 91006), Uppermost Skythian.

Fig. 4. *Procarnites* sp. .....p. 103
Reg. no. TMM 20028, ×1.6, collected at loc. **d** in Pualaca (Coll. no. TM 91302), Lowest? Anisian.

Figs. 5, 6. *Ptychites*? sp. .....p. 110
5. Reg. no. TMM 20039, ×1.1; 6. oblique section of outer whorl, Reg. no. TMM 20040, ×1.1, loc. and horizon *ditto*.

Figs. 7, 8. *Eumorphotis*? sp.
7. Reg. no. TMM 20047, ×2; 8. Reg. no. TMM 20048, ×2, collected at loc. **a**, west of Manatuto (Coll. no. TM 91815), Upper Skythian (Owenitan).

Figs. 9a, b. *Danubites* sp. .....p. 108
Reg. no. TMM 20037, natural size, collected from loc. **c**, west of Manatuto (Coll. no. TM 91807), Lower Anisian.



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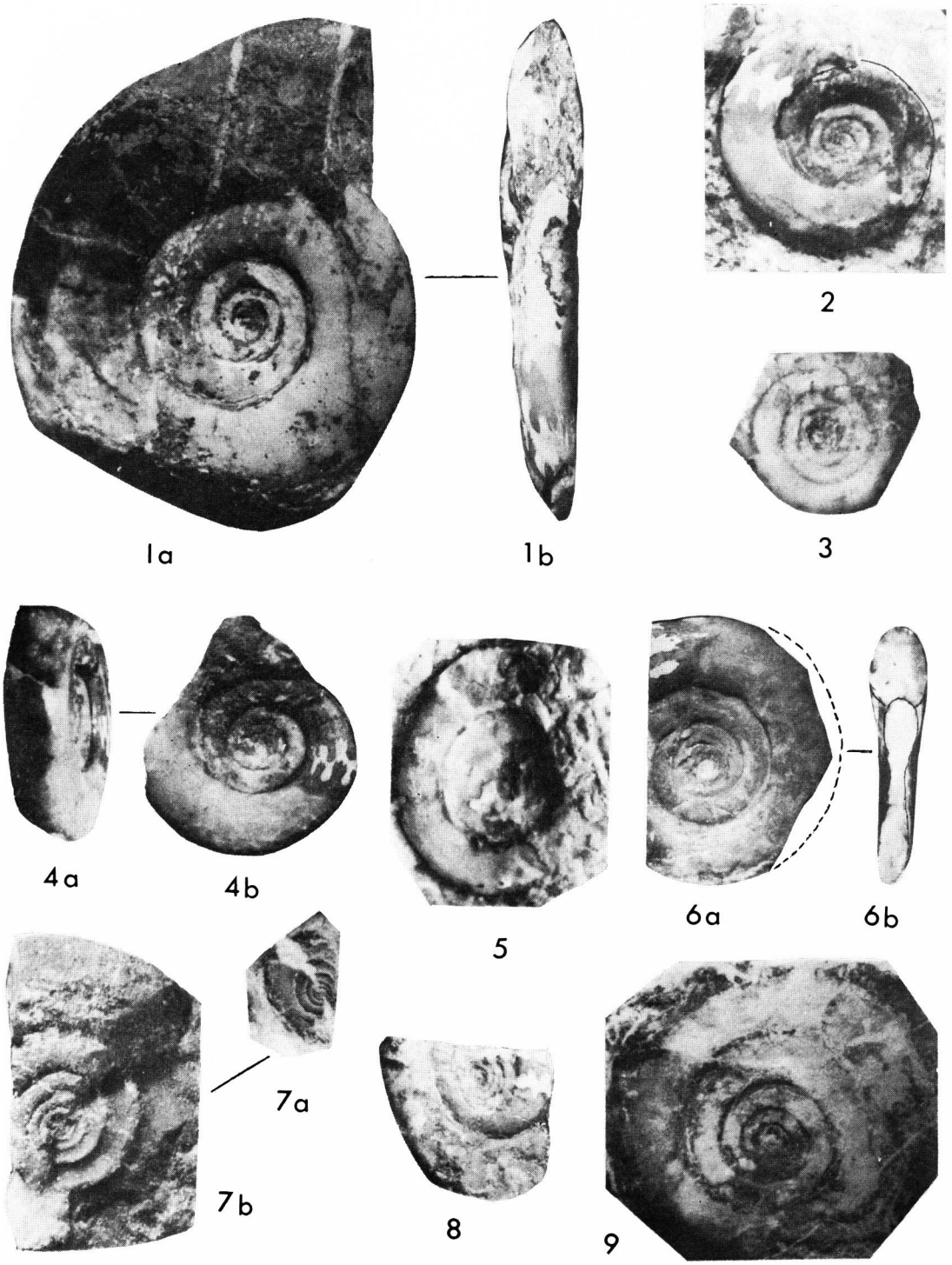
Explanation of Plate 7

Figs. 1a, b. *Leiophyllites* aff. *pitamaha* DIENER .....p. 106
Reg. no. TMM 20035, ×ca 1.3, collected from a limestone boulder of the Mota Mutin, Pualaca (Coll. no. TM 91302), Lowest? Anisian.

Figs. 2–7. *Leiophyllites timorensis* Bando, n. sp. .....p. 104
2. Reg. no. 20030a, ×1.7; 3. Reg. no. TMM 20031, ×1.4; 4a, b. Reg. no. TMM 20029, holotype, ×1.4; 5. Reg. no. TMM 20030b, ×1.7; 6a, b. Reg. no. TMM 20032, ×1.5; 7a, b. Reg. no. TMM 20034, (a) natural size, (b) counter part of (a), ×2.4.
All specimens were collected from loc. **d** west of Manatuto (Coll. no. TM 91006), Uppermost Skythian (Owenitan).

Fig. 8. *Leiophyllites* sp. .....p. 106
Reg. no. TMM 20033, ×1.1, locality and horizon *ditto*.

Fig. 9. *Leiophyllites*? sp. .....p. 107
Reg. no. TMM 20036, ×1.3, locality and horizon same as in Fig. 1.



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